Quentin Changeat

Nationality: French – phone: 0033 6 58 72 94 80 – email: qchangeat@stsci.edu / quentin.changeat@esa.int
Academic website: https://quentchangeat.github.io/ , ORCID: 0000-0001-6516-4493.

RESEARCH SUMMARY

Since 2019, I have co-authored 52 research articles in the field of exoplanets, including 11 first author (h-index: 19).

My research focuses on the analysis of current and future spectroscopic observations of exoplanets, planets outside our solar system, to understand the physics and the chemistry of their atmospheres. Using data-oriented techniques, I am interested in the properties of all planets, ranging from the temperate super-Earth LHS-1140b to the extremely-hot Jupiter KELT-9b, that I observed with the James Webb, Hubble and Spitzer Space Telescopes. Studying the properties of exo-atmospheres provides a unique window into their nature, but also how their formed and interact with their host star. In this context, I have pioneered in the development of tools (*TauREx3* and *Alfnoor*) adapted to analyze large populations of atmospheres and the extraction of 3D information from challenging phase-curve observations. I have also used those tools to support upcoming exoplanet missions such as the ESA-Ariel telescope and evaluate how they can help us answer some of the major questions of the field. To advance our understanding of exoplanets, my long-term strategy is to combine multiple disciplines and approaches to build a consistent picture of exo-atmospheres.

CURRENT POSITIONS

2022 Sep – Current: **European Space Agency (ESA) Research Fellow**
Space Telescope Science Institute (STScI), Baltimore (USA)

2022 Sep – Current: **Honorary Research Fellow**
Department of Physics and Astronomy, University College London (UK)

2022 May – Current: **Guest Researcher**
Centre for Computing Astrophysics (CCA), Flatiron Institute, Simons Foundation (USA)

PAST PROFESSIONAL EXPERIENCES

2021 Jan – 2022 Sep: **Postdoctoral Research Fellow**
Department of Physics and Astronomy, University College London (UK)

2016 Oct – 2017 Sep: **Staff Cybersecurity Consultant at Wavestone SA**
Cybersecurity division, Wavestone Paris (France). Consultancy services for large companies.

2015 Nov - 2016 Feb: **Freelance Consultant at OutSmart Insights Ltd**
OutSmart Insights Ltd, London (UK). Technology scanning for Aerospace & Defence companies.

EDUCATION

2018 – 2021: **PhD in Astrophysics -** *University College London* (UK)
- Title: Next generation techniques to characterise exoplanetary atmospheres – Supervisor: Prof. Giovanna Tinetti.
- Program completed in 2.5 years (1 year ahead of schedule).
- Jon Darius Memorial Prize for best thesis in Astrophysics 2021.

2017 – 2018: **Master (Part III) in Applied Mathematics -** *University of Cambridge* (UK)
- E.M. Burnett prize for excellent results.

2015 – 2016: **Master (MSc) in Environmental Technology -** *Imperial College London* (UK) – Grade: Merit

2013 – 2016: **Master (MEng) in General Engineering -** *Ecole des Mines Douai* (FRA) – Ranked top 1%.

2010 – 2013: **CPGE: Equiv. Bachelor Degree in Mathematics/Physics -** *Lycée Daudet* (FRA) – Grade: A

SUCCESSFUL PROPOSALS AND GRANTS ────────────────────

Obtained as PI or Science PI

Funding Proposals:

2023 – 2026: **ESA Science Faculty Research Funds**, "Exoplanet atmospheres in a new era.", funding to support a 3-year PhD student – <u>110,000 EUR</u>.

2022 – 2025: **ESA Research Fellowship**, "Deciphering exoplanetary atmospheres in the era of ESA Ariel and NASA-ESA-CSA JWST", independent research grant – <u>$300,000</u>.

2021: **JSPS Short-Term Research Fellowship** at NAOJ Japan, "From exoplanetary formation to atmospheric properties: A unified journey", funds for short-term project and visit – <u>¥800,000 JPY</u>.

2021 – 2023: **UKSA Postdoctoral Research Fellowship** at University College London, "ESA M4 Mission Ariel Implementation Phase", recipient of the external award (PI G. Tinetti) – <u>£200,000</u>.

Observing Proposals:

2022: **CHEOPS AO3**, "Atmospheric characterization of the hot-Jupiter WASP-79 b with CHEOPS" – <u>28 orbits</u>.

Computing Proposals:

2023 – 2026: **STFC DiRAC HPC RAC 15th**, "Characterization of exoplanet atmospheres with JWST", computing – <u>9.5M CPUh</u>.

Obtained as co-I

Observing Proposals:

2023: **CRIRES+**, "A holistic view of atmospheric chemistry: the synergies between JWST and ground-based spectrographs" – <u>10 hours</u>.

2022: **CHEOPS AO3**, "Cloudiness of three warm Sub-Neptunes" – <u>21 orbits</u>.

2022: **CHEOPS AO3**, "Ephemeris Refinement of Key Targets for the ESA-Ariel Mission" – <u>132 orbits</u>.

2022: **CHEOPS AO3**, "Constraining Refractory Species and Characterizing the Stellar Environment of the Inflated hot-Jupiter WASP-17 b" – <u>20 orbits</u>.

2022: **CHEOPS AO3**, "Rescuing Longer Period TESS Planet Candidates for Future Atmospheric Characterizations" – <u>130 orbits</u>.

2021: **HST Cycle 28**, "Atmospheric Characterization of A Disintegrating Planet in the Hot Neptune Desert" – <u>8 orbits</u>.

2019: **Las Cumbres Observatory**, "Refining Exoplanet Ephemerides" – <u>100 hours</u>.

Computing Proposals:

2023 – 2026: **STFC DiRAC HPC RAC 15th**, "In Search of an Interdisciplinary Solution for Scalable Planetary Characterization", computing time – <u>5M CPUh + 35k GPUh</u>.

LIST OF PUBLICATIONS ────────────────────

Summary of research contribution: 52 accepted research articles (11 first author) published in high impact journals between 2019 and Apr 2023. Full ADS list can be accessed at: https://ui.adsabs.harvard.edu/public-libraries/Bt4TNyP4RTOi1UoeyWElYg

Total number of accepted articles: 51 (11 first author)
ADS author h-index: 19
Total number of citations: 995

[1] **Changeat** & Yip. (2023): ESA-Ariel Data Challenge NeurIPS 2022: Introduction to exo-atmospheric studies and presentation of the Atmospheric Big Challenge (ABC) Database, *RASTI 2, 1. https://doi.org/10.1093/rasti/rzad001*.

[2] **Changeat** et al. (2022): Five Key Exoplanet Questions Answered via the Analysis of 25 Hot-Jupiter Atmospheres in Eclipse, *ApJS, 260, 3. doi:10.3847/1538-4365/ac5cc2*.

[3] **Changeat** (2022): On spectroscopic phase-curve retrievals: H2 dissociation and thermal inversion in in the atmosphere of the ultra-hot Jupiter WASP-103 b, *doi:10.3847/1538-3881/ac4475*.

[4] **Changeat** et al. (2021): An exploration of model degeneracies with a unified phase curve retrieval analysis: The light and dark sides of WASP-43 b, *ApJ, 913, 73. doi:10.3847/1538-4357/abf2bb*.

[5] **Changeat** and Edwards (2021): The Hubble WFC3 Emission Spectrum of the Extremely-Hot Jupiter, KELT-9b, *ApJL, 907, L22. doi:10.3847/2041-8213/abd84f*.

[6] **Changeat**, et al. (2021): Disentangling Atmospheric Compositions of K2-18 b with Next Generation Facilities, *Exp. Astron. Ariel Special Edition. doi: 0.1007/s10686-021-09794-w*.

[7] **Changeat**, et al. (2020): KELT-11b: Abundances of water and constraints on carbon-bearing molecules from the Hubble transmission spectrum, *AJ, 160, 260. doi:10.3847/1538-3881/abbe12*.

[8] **Changeat** and Al-Refaie (2020): TauREx3 PhaseCurve: A 1.5D model for phase curve description, *ApJ, 898, 155. doi:10.3847/1538-4357/ab9b82*.

[9] **Changeat**, et al. (2020): Alfnoor: A Retrieval Simulation of the Ariel Target List, *AJ, 160, 80. doi:10.3847/1538-3881/ab9a53*.

[10] **Changeat**, et al. (2020): Impact of planetary mass uncertainties on exoplanet atmospheric retrievals, *ApJ, 896, 107. doi:10.3847/1538-4357/ab8f8b*.

[11] **Changeat**, et al. (2019): Towards a more complex description of chemical profiles in exoplanets retrievals: A 2-layer parameterisation, *ApJ, 886, 39. doi:10.3847/1538-4357/ab4a14*.

SELECTION OF TALKS

2023 Mar:	**ESLAB 2023 Symposium** (Netherlands) – "Modern analysis techniques for exoplanet data" (Keynote Speaker).
2023 Mar:	**SRON** (Netherlands) – "Towards population studies of exoplanet atmospheres" (Seminar).
2022 Dec:	**ESA SCI Science Workshops** (Netherlands) – "Towards population studies of exo-atmospheres" (Contributed).
2022 Aug:	**CCA Exoplanet Symposium** in NY (USA) – "Atmospheric Retrievals and more" (Contributed).
2022 Aug:	**NASA Jet Propulsion Lab** (USA) – "Towards population studies of exoplanets" (Seminar).
2022 Feb:	**Tokyo University** (JP) – "Challenges in analyses of exo-atmospheres in the era of JWST and Ariel" (Seminar).
2021 Dec:	**NASA Goddard** (Virtual) – "Atmospheric studies in the era of next generation telescopes" (Seminar).
2021 Dec:	**Exosystèmes II** in Toulouse (France) – "Phase-curve retrievals of exo-atmospheres: WASP-43b" (Contributed).
2020 Dec:	**Ariel ARES days** (Virtual)- "Phase-curve retrieval studies of exo-atmospheres" (Contributed).
2020 Mar:	**Tokyo University** (JP) – "Seminar on atmospheric retrievals" (Seminar).
2020 Jan:	**Rocky Exo-worlds Conference** in Cambridge (UK) – "Presentation of ESA-Ariel" (Contributed).
2019 Oct:	**Tokyo University** (JP) – "Degeneracies in atmospheric retrievals for future space telescopes" (Seminar).
2019 Sep:	**EPSC-DPS 2019** in Lyon (FR) – "Data analysis techniques in the era of next generation telescopes" (Contributed).
2019 Jul:	**University of California Berkeley** (USA) – "Towards more complex chemical parametrisation for atmospheric retrievals of exoplanets" (Seminar).
2019 Jul:	**NASA Jet Propulsion Lab** (USA) – "Towards more complex chemical parametrisation for atmospheric retrievals of exoplanets" (Seminar).
2019 Jul:	**California Institute of Technology** (USA) – "Towards more complex chemical parametrisation for atmospheric retrievals of exoplanets" (Seminar).

Other contributed talks at **more than 20 events**, including ESA Ariel Consortium meetings (EU locations) – 2018 to Present.

ACADEMIC SERVICES

2023:	Organiser of the 2023 Ariel Data Challenge in ECML.
2022:	Organiser of the 2022 Ariel Data Challenge in NeurIPS.
2022 – Now:	Member of the JWST ERS Transiting Exoplanet team.
2021:	Organizer of the ARES II Summer School, Biarritz FR.
2020 - Now:	Leader of the Spectral Retrieval working group for the ESA Ariel Mission.
2020 – Now:	Reviewer for ApJ, A&A, MNRAS, JOSS, Exp. Ast., Astrophys. Space Sci.

STUDENT SUPERVISION

2021 Oct – 2022 Sep:	Fang Wang, PhD Chinese Academy of Science – external supervisor.
2021 Oct – 2022 Sep:	Zofia Hermaszewska, MSc Astrophysics UCL – thesis primary supervisor.
2021 Oct – 2022 Sep:	Christos Xenofontos, MSc Planetary Science UCL – thesis primary supervisor.
2021 Oct – 2022 Sep:	Connor Ballard, MSc Planetary Science UCL – thesis second supervisor
2021 Oct – 2022 Mar:	Estelle Janin, MSc Astrophysics UCL – thesis primary supervisor.
2021 Jun – 2021 Sep:	Lorenzo Pica Ciamarra, Summer Intern UCL – project supervisor.
2020 Oct – 2021 Sep:	Alexandra Thompson, MSc Astrophysics UCL – thesis primary supervisor.
2019 Oct – 2020 Sep:	Luke Keyte, MSc Astrophysics UCL – thesis primary supervisor

TEACHING EXPERIENCES

2022 Mar:	Rencontre Exobiologique pour Doctorants (RED 22) school, Le Teich FR – invited lecturer.
2021 Dec:	Exosystèmes II Conference, atmospheric retrievals with TauREx, Toulouse FR – hands-on lead.
2021 Sep:	ARES II Summer School, Biarritz FR – school organiser and lecturer.
2019 Sep:	ARES I Summer School, Biarritz FR – invited lecturer.
2019 Feb:	Digital Exoplanet Conference, Prague CZ – hands-on lead.

2018 – 2019:   Marker for the MSc course PHAS0068, "Physics of the Exoplanets" – course marker.

OUTREACH

2022 May:	**Pint of Science**, Paris FR – public talk.
2020 Dec:	**Astronomines Conference**, Ecole des Mines Saint-Etienne FR (Online) – public talk.
2019 Nov:	**Conférence Astronomie**, Lycée Jacque Prévert and Saint-Christol-les-Ales FR – public talk.
2019 Oct:	**Space Café**, Tokyo JP – public talk.
2018 – 2020:	**ORBYTS program**, BSSL, bimonthly courses on exoplanets to high-school students with planification of LCO and TelescopeLive observations, led to two publications – teacher.
2019 – Now:	Promotion of science via press and online articles:

- ESA/UCL/NVIDIA/CNRS PR: "Hubble observations used to answer key exoplanet questions"

- ExoClock Ariel article: "The prospects of phase curve studies in the Ariel era".

- The Conversation: "AI can reliably spot molecules on exoplanets…".

- The Conversation: "How can some planets be hotter than stars?".

- Science & Vie: "Le mystère des planètes vaporeuses".

- All About Space Magazine: "What are hot-Jupiters?".